DESCRIPTION

MOBILE PHONE SYSTEM AND MOBILE PHONE TERMINAL USING A PLURALITY OF TELEPHONE NUMBERS

1. Technical Field

The present invention relates to a mobile phone system and mobile phone terminal which assign a plurality of phone numbers to single mobile phone and perform various call processing and/or responses according to a requested phone number contained in call request signal among the assigned two or more mobile phone numbers.

2. Background Art

In general, telephone terminals are regarded as the most universal communication means to transceive (transmit/receive) messages that users want to send via voice format. The telephone terminals are divided into a wired phone and a mobile phone terminal. The wired phone terminal is sub-divided into a corded phone and a cordless phone terminal. The cordless phone terminal refers to a phone terminal having additional portable apparatus, that is, a cordless handset used for communicating with main set of a corded phone terminal. This cordless phone terminal has a limited usable range

of telephone call due to the fact that the portable handset always has to communicate with main set of a corded phone terminal.

On the other hand, the mobile phone terminal can directly connect to telephone network and communicate irrespective of main set of a corded phone terminal, having broad range of telephone call. Especially, the usage of mobile phone terminals has been increasing rapidly because telephone call service of good quality and various value-added services is provided with recent development of communication technology.

By the way, aforementioned mobile phone terminal has a unique phone number assigned to itself such that it can be distinguished from each others. In addition, the available spare frequency band which will be allocated to new mobile communication system is dramatically decreasing due to the rapidly increasing usage of mobile phones.

Therefore, the conventional communication schemes such as FDMA (Frequency Division Multiple Access) and TDMA (Time Division Multiple Access) are being replaced with a new communication scheme that can make more efficient use of the given frequency band, that is to say, CDMA (Code Division Multiple Access), which recently has been

proposed by Qualcomm Inc.

However, the conventional mobile phone service has some drawbacks. Firstly, a mobile phone subscriber is not allowed to have a plurality of phone numbers with single phone terminal, so that he or she has only single phone number on single mobile phone. Therefore, users who want to have plural phone numbers have no choice but to purchase the same number of mobile phone terminals, giving subscribers economic burden and much inconvenience. Secondly, a callee with single mobile phone can not identify a caller, which makes the callee respond to the caller without having an idea of who is calling and may give subscribers a mental burden. In addition, a callee can not figure out if the received call is emergent or not, making it difficult to promptly respond to a emergency call.

So, in order to mitigate the economic burden that the multiple mobile phone terminals must be purchased, several conventional arts have already been proposed in Korea patent publication No. 96-16879 and Korean patent preliminary publication No. 97-705315.

However, even though the conventional arts have proposed a method for assigning a plurality of phone numbers to single mobile phone terminal, all of the

plural phone identification information (numbers) in the proposed conventional arts are independent subscriber phone numbers which can be assigned to and used for other phone terminal users and they are all assigned to single subscriber who has joined mobile phone service. Therefore the conventional arts fail to provide method for using the limited frequency band more efficiently. In addition, the conventional arts do not present appropriate call response and call processing methods for using plural phone numbers in mobile phone terminals.

Seeing from the viewpoint of power consumption, which is very important in mobile phones because the installed battery is of small quantity, the conventional arts also has a disadvantage of consuming much power due to the process of continuous communication with mobile phone base station for a instant paging/accessing, that is, periodically transmitting a plurality of phone terminal identification information corresponding to the assigned plural subscriber phone numbers to inform mobile phone system of mobile phone's position and status. This results in rapid increase of power consumption needed for communicating with base stations in standby mode, hence reducing battery operation time dramatically.

3. Disclosure of Invention

It is an object of the present invention to provide a mobile phone system and a mobile phone terminal using a plurality of telephone numbers. A plurality of telephone numbers are assigned to single mobile phone terminal such that the limited frequency band can be utilized efficiently. Call response and call processing can be performed differently according to called phone numbers, each number is correspondent to each assigned plural telephone numbers respectively.

It is another object to provide a voice mailing service of storing voice messages separately according to plural phone numbers and identifying pre-stored voice messages distinguishably for all of the plural phone numbers.

The mobile phone system in accordance with the present invention, which has been proposed to achieve the mentioned objectives, firstly information on called part, that is, telephone number is extracted from a received call request signal and then whether or not the call request signal is associated with a mobile phone terminal which has joined multiple phone numbers service is checked based on the extracted telephone number. If the telephone number is for plural telephone number service, the phone terminal identification information and phone

number identification information which are corresponding to the called telephone number are extracted, the phone number identification information discriminating plural telephone numbers. And then, the call request is processed complying with the extracted identification information. As a result of the call processing, the phone terminal identification information or phone number identification information is extracted from a call connection request signal received from a switching node via radio at the side of mobile phone terminal, and a mobile terminal may respond to the call connection request differently based on the extracted the phone terminal identification information or phone number identification information and display the extracted information.

The mobile phone system and terminal according to the present invention has many advantages. Firstly, subscribers can use multiple phone numbers with single mobile phone. Secondly, subscribers can take versatile call processing, call response and voice mailing service in accordance with the multiple phone numbers. Thirdly, battery power consumption which is needed for communicating with mobile base station in standby mode can be minimized.

4. Brief Description of Drawings

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate the preferred embodiment of this invention, and together with the description, serve to explain the principles of the present invention.

In the drawings:

FIG. 1 shows a typical block diagram of general mobile phone network;

FIG. 2 shows a block diagram of a mobile switching node in accordance with the present invention;

FIG. 3 describes CDMA mobile phone code channels;

FIG. 4 shows a block diagram of a mobile phone terminal in accordance with the present invention;

FIGS. 5A and 5B are flow charts for describing the operation of a mobile phone system in accordance with the present invention;

FIGS. 6A and 6B are flow charts for describing call processing methods of mobile switching node in accordance with the present invention;

FIGS. 7A and 7B are flow charts for describing call responding methods of a mobile phone terminal in accordance with the present invention; and

FIG. 8 is a flow chart for describing voice mailing

procedures of a mobile phone system in accordance with the present invention.

5. Modes for Carrying out the Invention

The preferred embodiments of the present invention will be described hereinafter in detail referring to the accompanying drawings.

FIG. 1 depicts a conceptual representation of the mobile phone network using a plurality of phone numbers, which includes a telephone communication network 2 linked with multiple telephones 1, a telephone network interface unit 3 connected to the wired and/or wireless telephone communication network 2, a mobile phone controller 4 performing a call processing according to a call request signal received via the telephone communication interface unit 3, a data storage unit 5 storing data necessary for call processing of the mobile phone controller 3, and mobile phone base stations 6 sending the call-processed signal to a mobile phones via radio.

FIG. 2 shows a more detailed block diagram of mobile switching node Sx including functional blocks of the telephone network interface unit 3, the mobile phone controller 4, and the data storage unit 5.

FIG. 2 depicts sub-blocks of a telephone network interface unit 11 transceiving call signal and voice

signal with being linked to the wired and/or wireless telephone communication network 2, a hard disk 14 storing telephone identification information contained in a call request signal and call processing data corresponding to the telephone identification information, a database 20 where voice message and guiding message are stored in digital data format, an ADPCM unit 19 which performs adaptive differential quantization of voice signal into voice digital data, a voice conversion unit 18 which transforms the digital data stored in database into voice signal, a DTMF processor 12 which interprets dual tone multiple frequency (DTMF) signals received from the telephone network interface unit 11, a controller 13 which generates control signals in accordance with the DTMF signal, a call processing unit 15 which generates a call connection request signal in accordance with the control signals, several multiplexers 21 transmitting a call connection request signal generated from the call processing unit 15 to multiple mobile phone base stations or selectively outputting signals received from mobile phone base stations, and a link interface unit 22 transmitting switched signals of the multiplexers 21 to another mobile switching node.

The operation of mobile switching node Sx of FIG. 2

will now be described in detail with reference to the accompanying drawings

FIG. 3 shows mobile phone code channels of CDMA system to which the embodiment of the present invention is applied.

The conventional CDMA signal uses 64 code channels consisting of 1 pilot channel, 1 sync channel, 7 paging channels, and 55 traffic channels.

The pilot channel transmits an unique non-modulated signal generated by mobile phone base station, which will be used for discriminating cell or sector of the mobile phone base station. The sync channel is used for synchronization of a mobile phone to a base station.

The paging channels are used for mobile phone base station to call a mobile phone and the traffic channels are used for transceiving voice messages of a mobile phone responded to the call. The paging channels also have information with which the phone number requested by a caller can be recognized. The paging channels in accordance with the present invention contain a phone terminal identification information for indicating the called mobile phone and plural phone number identification information for discriminating plural phone numbers used by the requested mobile phone.

Now, the operation of the mobile switching node Sx is explained. Upon receiving a call request signal via the telephone interface unit 11, the controller 13 detects a phone terminal identification information contained in the call request signal and checks if the requested mobile phone has joined a service using a plurality of phone numbers. If the phone terminal identification information is associated with a mobile phone using a plurality of phone numbers, the controller 13 extracts associated phone number identification information and performs call processing such as sending call connection request signal corresponding to the extracted phone number identification information.

Meanwhile, a mobile phone 7 extracts a phone terminal identification information contained in a call connection request signal received through mobile phone base station 6 from the mobile switching node Sx and checks if it corresponds to itself. If then, the mobile phone extracts a phone number identification information contained in the call connection request signal and recognizes that there has been a call connection request to a phone number among a plurality of phone numbers pre-assigned to itself.

A preferred examples for recognizing the plural

telephone numbers is explained. Suppose that a phone terminal identification information used by a mobile phone, which is to be carried in the paging channels, is 8-bit length code and the mobile phone uses 4 different plural phone terminal numbers.

In such a case, the minimum number of data bit to discriminate the 4 telephone numbers assigned to a multiple number subscriber is 2 (00, 01, 10, 11). Thus, the paging channel is transmitted, which contains a phone terminal identification information of 8 bits for discriminating a requested mobile phone and a phone number identification information of 2 bits for discriminating 4 assigned telephone numbers used by a callee. the telephone numbers used by a subscriber are assigned independently of the digit values of phone number identification information since the called telephone number is translated into a phone terminal identification information and one of phone number identification information.

FIG. 4 shows the block diagram of a mobile phone terminal in accordance with the present invention, which comprises a frequency conversion unit 31 converting up/down frequency of a signal received from a mobile phone base station or a signal generated from a mobile

phone, a mod/demodulation unit 32 performing modulation/demodulation of a received signal, a protocol processing unit 33 decrypting/encrypting data for communication from the modulated/demodulated signals, a vocoder 35 decoding the voice digital data to voice analog signal, an encoder 36 encoding voice analog signal to digital voice data, a microprocessor 34 controlling call response and overall operation according to the data interpreted in the protocol processing unit 33, a storage unit 39 storing information needed for control of the call response and operation, a display unit 38 displaying call response status and information of call connection request, and a speaker/microphone module37 output and input the voice analog signal.

The following is the detailed explanation of call processing procedures according to the present invention.

FIGS. 5A and 5B are flow charts showing the call processing procedures of mobile phone system allowing a plurality of phone numbers for single mobile phone terminal in accordance with the present invention. Specifically, FIG. 5A is a flow chart of operations performed in the mobile switching node Sx, and FIG. 5B is a flow chart of operations performed in a mobile phone terminal, where the operations of mobile phone base

station is omitted.

The following explains the operation of a mobile phone system allowing a plurality of telephone numbers in accordance with the present invention.

When mobile switching node Sx receives a call request signal during standby mode, which means that a call request signal is received through the telephone interface unit 11 linked to the wired and/or wireless telephone communication network 2, the DTMF processor 12 detects dual tone multiple frequency signal contained in the received call request signal and outputs digit information corresponding the detected dual tone multiple frequency signal. Using the digit information which corresponds to a telephone number of a called mobile terminal, the controller 13 checks if the called telephone number is served by the mobile switching node Sx itself and if it is associated with plural telephone number service. The checking process is performed by searching the hard disk 14 containing the subscribers' service information.

If it is a telephone number for a subscriber who uses plural telephone numbers, the controller 13 extracts phone terminal identification information related to the requested telephone number from the subscribers' service

information or the call request signal if provided, and then transmits a phone number identification information corresponding to the requested telephone number to the call processing unit 15 (S13) together with the phone terminal identification information, a phone number identification information being stored in the hard disk 14 in connection with the extracted phone terminal identification information. The call processing unit 15 generates a call connection request signal containing both the phone terminal identification information and phone number identification information, based on the call request from the controller 13, and transmits it to one of the multiplexers 21 linked with mobile phone base stations, making the call connection request signal be sent to a mobile phone (S14).

Meantime, upon receiving (S31) the call connection request signal through mobile phone base station during standby mode (S30), a mobile phone terminal detects a phone terminal identification information contained in the call connection request signal and checks if itself is requested. Considering these procedures more specifically, the frequency conversion unit 21 converts a signal received from a base station via antenna into a intermediate frequency signal and then into baseband

signal. The mod/demodulation unit 32 demodulates the baseband signal into digital signal.

The protocol processing unit 33 interprets the demodulated digital signal into decrypted data from which the microprocessor 34 extracts the phone terminal identification information. Then, the microprocessor 34 checks whether or not the extracted phone terminal identification information corresponds to its own identification information pre-stored in the memory 39. If the extracted phone terminal identification information corresponds to its own one, the microprocessor 34 extracts a phone number identification information from the decrypted data interpreted by the protocol processing unit 33, and reads out data of call response preset for the extracted phone number identification information from the memory 39.

After then, the microprocessor 34 checks what type of response mode the read data of call response indicates. If the read data of call response indicates a normal call responding mode, the microprocessor 34 retrieves and checks an alert data for call arrival associated with the extracted phone number identification information which has been stored in the memory 39, and controls the alerting device, which may be the microphone 37 or the

display unit 38, to output alerting signal corresponding to the read alert data. For example, if the alert data for call arrival indicates sound, an alerting signal can be either "bee-bee" or "too-too" sound according to the phone number identification information, so that the type of alerting sound enables a callee to recognize a called telephone number directly and immediately.

As another example, if an alert data for call arrival is vibration, a callee can distinguish a called telephone number by recognizing the period or magnitude of vibration pre-specified according to the phone number identification information. In a case that an alert data for call arrival is set to a lamp such as light emitting diode (LED), a called telephone number can be discriminated by a callee based on the brightness or on-and-off period of a lamp in the display unit 38 since the brightness or the on-and-off period is differently preset according to each of the phone number identification information. In a case that an alert data for call arrival is set to characters, a called telephone number can be discriminated by a callee based on alerting characters showing the phone number identification information in direct as displayed in the display unit 38.

After alerting the call arrival, if there enters a key

through a keypad unit 41 (S37) to accept the call connection request, a call response signal responding to the call connection request signal is sent to any mobile phone base station (S38), thereby a call connection can be established.

The operation for call connection is explained in more detail. If a predetermined key such as a "SND" key on the keypad unit 41 is entered, the microprocessor 34 detects the key-in and then controls the protocol processing unit 33 to generate a call response data. The call response data generated in the protocol processing unit 33 is modulated into a call response signal by the mod/demodulation unit 32 and again are converted to a high-frequency signal by the frequency conversion unit 31, being transmitted via radio.

The call response signal is transmitted to mobile switching node Sx via mobile phone base station. The mobile switching node Sx receives the call response signal and checks if the received call response signal is based on conditional or unconditional call connection (S17). If the call response signal indicates unconditional-based, then the controller 13 of mobile switching node Sx controls the switching unit 16 and the multiplexer 21 to setup a connection between a caller and

a callee.

If the mobile phone terminal gets a keypad signal of ending call connection from the keypad unit 41 while connection is setup, the mobile phone terminal transmits a call disconnection signal to the mobile switching node Sx via mobile phone base station. Upon receiving the call disconnection signal (S19), the mobile switching node Sx disconnects the signal path between caller and callee (S40) and enters standby mode (S20), thereby the mobile phone terminal also goes back to standby mode (S41).

Meanwhile, the steps S22 and S42 of FIG. 5A and 5B representing conditional call connection processes a requested call in different ways according to call response data of a mobile phone terminal or call processing data of the mobile switching node Sx1.

The conditional call connection can be performed independently in either a mobile phone terminal or a mobile switching node depending upon which is easier to embody. Several examples of conditional call connection are explained as follow referring FIGS. 6A, 6B, 7A, and 7B.

FIGS. 6A and 6B show examples that a conditional call connection is processed in mobile switching node Sx independently of mobile phone terminal . At first, the

controller 13 searches for a phone terminal identification information corresponding to a called telephone number contained in a received call request signal (S51) during standby mode (S50), and, if discovered, checks whether the discovered phone terminal identification is associated with a mobile phone terminal having plural telephone numbers. If then, the controller 13 also navigates the hard disk 14 to find phone number identification information corresponding to telephone number which current call is requested to.

The controller 13 reads out call processing information stored in connection with the found phone number identification information in hard disk 14 and checks whether the read call processing information indicates call rejection or not. If the call processing information indicates call rejection, guiding message data having been stored in the database 20 in format of digital compressed data are retrieved. The retrieved guiding message data are restored to voice analog signal by the voice conversion unit 18, and transmitted to the caller, notifying that the request call has been rejected.

In addition, as for the guiding messages corresponding to the call rejection, it is more desirable to adopt indirect and polite expression rather than announcement

expressing call denial directly so that a caller may not feel unpleasant. For example, a guiding message can be like this, "it is impossible to connect the requested subscriber now because the mobile phone has been powered-off, please call it again later". Such a expression can lead the caller not to recognize that the requested subscriber is rejecting his or her call.

If the call processing information stored in connection with the found phone number identification information indicates time-conditional call (S57), the controller 13 detects current time (S58) and compares it with call restriction time or call connection time which is preset by a subscriber's request (S59). If the current time is within the preset call restriction time, a guiding message representing the above expression is retrieved and transmitted to the caller, and if the current time does not belong to the call restriction time, normal call processing operation such as transmitting a call request signal is accomplished, which has been described hereinbefore.

If the call processing information stored in connection with the found phone number identification information indicates call routing to voice mailing system (S70), a guiding message informing that the request call is re-

routed to voice mailing system is transmitted (S71) and the conventional voice mailing service is provided after connection to the voice mailing system is established (S72). In case that the voice mailing system is united to a mobile switching node as shown FIG. 2, analog voice signal received through the telephone network interface unit 11 is converted into digital data by the ADPCM unit 19 and is stored in connection with the extracted phone terminal identification information in the database 20.

If the call processing information stored in connection with the found phone number identification information indicates region-conditional call (S74), the controller 13 detects current location (S75) by interpreting the pilot and/or paging channel signal from neighboring mobile base station, and compares current location with call restriction region which is preset by a subscriber's request (S75). if the detected current location is within the preset call restriction region, a guiding message refusing call connection is transmitted and again standby mode is sustained (S73).

In cases of the call restriction, time-conditional call connection, and region-conditional call connection, the requested call can be rejected such a way that a guiding message refusing call connection is replaced with a voice

menu message of voice mailing service and the request call is unconditionally re-routed to a voice mailing system.

FIGS. 7A and 7B are flow charts for showing how to respond a call connection request response according to the type of conditional call connection in a mobile phone terminal. When a call connection request signal from a mobile switching node is received in standby mode (S81), a phone terminal identification information is extracted from the received call connection request signal (S82). Then, mobile phone terminal checks if the call connection request signal is destined to its own terminal, if then, a phone number identification information contained in the call connection request signal is extracted too (S83).

The microprocessor 34 of mobile phone terminal reads out the data of call response stored in connection with the extracted phone number identification information from the memory 39 and checks whether the read data of call response indicates call rejection or not. If it is call rejection, the mobile phone terminal sends call response signal notifying call rejection to a neighboring base station (S85) and the mobile switching node Sx connected to the base station receives the call response signal whereby the mobile switching node Sx performs the

operation of call rejection.

If the read data of call response associated with the extracted phone number identification information indicates time-conditional call, current time is retrieved (S87) from a timer (not figured) or is obtained from the time information received from mobile base stations and then is compared (S89) with call restriction time or call connection time which is preset by a user's key-ins for each phone number identification information. If the detected or obtained current time is within the preset call restriction time, the call response signal notifying call rejection is transmitted (S85) to a mobile base station as aforementioned.

If the read data of call response associated with the extracted phone number identification information indicates call reverting to voice mailing system (S100), a call response signal to revert the call connection to voice mailing system is generated and transmitted (S101). If the read data of call response associated with the extracted phone number identification information indicates region-conditional call (S103), call responding procedure is as follows. At first, the current location of a mobile phone terminal is evaluated by detecting and analyzing non-modulated signal of pilot channel which

discriminates the cell or sector of a certain base station, and is compared with the call restriction region preset by user in connection with the phone number identification information. If the current location belongs to the call restriction region, the call response signal to reject the call connection request is transmitted (S101) and again standby mode is sustained (S102).

If the read data of call response associated with the extracted phone number identification information indicates user-conditional call response (S107) in which a user decide how the call connection request to be processed, an alert information on call arrival stored in connection with the phone number identification information is retrieved from the memory 39 and an alert signal of call arrival assigned by the retrieved alert information on call arrival is generated (S108). After then, if a user presses a key to select call response mode (S109), call response processing is performed according to the user's selection (S110). The user can select 'call connection', 'call rejection', or 'conditional connection' by pressing corresponding key. For example, if the user selects a time-conditional call connection, a mobile phone terminal performs above-

mentioned procedures of time-conditional call connection, that is, it detects current time, comparing the current time with call restriction time, and requesting call connection or call rejection to a mobile switching node.

In a case of refusing call connection according to 'call restriction', 'time-conditional call connection', 'call reverting', and 'region-conditional call connection', the alert operation of call arrival described above, for example alarm sound or phone vibration, according to the call alerting information stored in connection with each phone number identification information can be omitted.

Considering the communication between a mobile phone and a corresponding base station for the present invention, it is enough to send only a common phone terminal identification information in standby mode in order to notify neighboring base stations of the location of a mobile phone terminal since plural telephone numbers used by a subscriber can be recognized from a common phone terminal identification information and plural phone number identification information being different with each other. Therefore power consumption needed for transmitting information in standby mode can be reduced.

FIG. 8 shows a flow chart for a method of voice mailing

service in a mobile phone system according to the present invention. At first, upon receiving (S120) a call request signal through the telephone network interface unit 11, the controller 13 extracts a called telephone number from the call request signal, searches for a phone terminal identification information corresponding to the called telephone number, and, if it discovered, checks whether a mobile phone terminal which the call request is destined to has joined plural telephone number service or not (S121). If the mobile phone has joined plural telephone number service, the controller 13 also searches for a phone number identification information corresponding to the called telephone number on the subscribers' service information(S122).

Then, the requested call is diverted to voice mailing system according to the call processing or call response as was explained referring to FIG. 6B, or is connected to voice mailing system through a conventional connection procedure (S123), where it is checked (S124) if the requested voice mailing service is voice recording or voice listening. In a case of voice recording, the controller 13 retrieves guiding message data for voice recording, which may be expression of "after bee sounds, please record your message and push the asterisk button

when the recording finishes", stored in the database 20, and the retrieved data are converted into analog voice signal by the voice conversion unit 18. After outputting a voice guiding message (S125), the controller 13 waits to receive voice messages from the caller.

If voice signal is received (S126), it is quantized into compressed digital data by the ADPCM unit 19. Upon receiving a key (for example '#') confirming that voice to be recorded is finished (S127), the controller 13 stores the compressed digital data in the database 20 together with the discovered phone number identification information (S128).

If the requested voice mailing service is voice listening at the step S124, the controller 13 reads out a guiding message data demanding the entrance of password from the database 20.

The read guiding message data like "please enter the password" is converted into analog voice signal by the voice conversion unit 18, which is then outputted (S130). After then, if the entered password matches with a pre-stored one (S131), the controller 13 sequentially retrieves all of the voice messages recorded and all the phone number identification information stored in connection with corresponding voice messages (S132). Both

the retrieved phone number identification information and the recorded voice data are converted into voice signal by the voice conversion unit 18 and sent to a user who has requested voice listening service, so that the user gets not only the stored messages but also the corresponding telephone number to which the recorded message is destined.

The above explanation specifically describes the structure and operation of a mobile phone system and mobile phone terminal as an embodiment of the present invention, which use plural telephone numbers being a combination of a phone terminal identification information and plural phone number identification information. However, this is only a preferred embodiment of the present invention, therefore the present invention can be further extended, if necessary, to a mobile phone system and a terminal that use plural phone terminal identification information in order to use plural telephone numbers. In such a embodiment, diverse call processing, call response and voice mailing service suggested by the present invention also can be done successfully.